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ROGUE RIVER AREA, OREGON.

A STUDY OF DENDROCTONUS BREVICOMIS INFESTATIONS  
IN YELLOW PINE.

FIFTH SUPPLEMENTARY REPORT.

DATA FOR 1924 AND PREVIOUS.

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Forest Insect Field Station.  
Bureau of Entomology.  
Palo Alto, California.  
December 15, 1924.

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ROGUE RIVER AREA, OREGON.

FIFTH SUPPLEMENTARY REPORT.

Data for 1924 and Previous.

INTRODUCTION:

A study of an epidemic infestation of Dendroctonus brevicornis in yellow pine on the Rogue River Area of southern Oregon was undertaken by the Ashland Station in the spring of 1914. This study was continued throughout the first epidemic period which lasted through the years 1915, 1916, and 1917, but the data accumulated was not adequate to more than indicate the behaviour of infestations under natural conditions. Accordingly it was deemed advisable to continue the study until such time as sufficient data on all phases of the infestations were secured to make possible the forecasting of epidemics and their probable duration. However, on account of the great size of the area, its contiguity to other infested areas, and to the limited amount of attention that could be given it, it was decided to limit further investigations to a study of the progress of the infestation and the amount of timber killed. Investigations on the project subsequent to 1918 have been limited in accordance with this plan to the making of an annual survey to determine the amount of timber killed and to brood analyses of infested trees on certain units.



#### PREVIOUS REPORTS:

A series of reports giving in detail the investigations conducted and their results have been submitted. A list of these reports with the dates of their issuance is as follows:

Preliminary Report - March 1918

Progress Report - March 15, 1919

First Supplementary Report - March 15, 1921

Second Supplementary Report - Feb 3, 1922

Third Supplementary Report - March 5, 1923

Fourth Supplementary Report - Jan 17, 1924.

The present paper is fifth in the series of supplementary reports and presents the results of the 1924 survey and investigations.

#### METHODS EMPLOYED:

Early in the study, it was apparent that, in order to insure reliable comparison of yearly losses identical methods of making the annual surveys were a necessity. Therefore the following method was adopted and rigidly adhered to. The area as a whole is covered every year by traversing the high ridges and open spaces and viewing the exposures seen from these points. The trees killed during the year on these exposures are counted. An estimate is made of the total annual loss by multiplying the trees actually counted by a factor determined by viewing an area and then making an intensive cruise of it. The Lamb's, Ashland, and Frederick, units are used for this intensive cruise, and a coefficient of 2 expresses the discrepancy between the results obtained from the estimate and the cruise.



### 1924 SURVEY:

The survey of 1924 was made in October and early November, by the usual methods, but the results did not give the total years loss since not all of the trees killed during the year had faded sufficiently to be detected. It will not be possible to ascertain the total 1924 loss until May or June 1925. However, to approximate the loss, for purposes of this report, the survey figures were interpolated by increasing the coefficient 25%. The results obtained in this way compared closely with the total loss on the cruised units. The area will be resurveyed next spring, after all infested trees have faded, to check up with the figures for 1924 given in this report.

### RESULTS:

With the results of the 1924 survey available we now have in hand the annual Dendroctonus brevicornis loss from 1914 to 1924 inclusive—a period of 11 years. These annual infestations cover a longer period of consecutive losses on a given area than have been secured elsewhere and, on account of the length of the period, are of unusual value in showing the progress of an infestation under natural conditions.

Tables I and II show the annual losses and the percents of stand killed during the period. The percents of the increases and decreases given in the tables show the annual fluctuations of the infestations from year to year. These fluctuations were quite pronounced during the early years, from 1914 to 1918, but were of lesser degree and more uniform since 1918.

The first epidemic infestation occurred in the years 1915 and



1916, killing during this period, 1.9% of the stand. This was followed by a decline of 56% during 1917 when the infestation reached a comparatively low point. In 1918 the infestation again became epidemic, killing 7% of the stand, which was an increase over 1917 of 78%. From 1918 the infestation gradually declined, with minor fluctuations, until 1923, when it reached the lowest point recorded, killing only .13% of the stand. From this point the infestation showed a decided upward trend and in 1924 made an increase over 1923 of 82%. The infestation may continue to mount in 1925 or it may decline as it did following the 78% increase in 1918.

One striking similiarity of the progress of the infestation is the regularity of the 4 year cycles. Beginning with the low point in 1914 the subsequent low points in 1917 and 1921, showed 3 year intervals. Likewise the peaks occurred every fourth year beginning with 1915 and followed by the peaks in 1918 and 1922. If the study of other infestations show similiar results we may expect relatively high infestations with heavy losses every fourth or fifth year.

Table II shows that there was no great difference in the cycles of the infestations in the separate units. There were minor fluctuations recorded which, however, do not greatly depart from the general trend.

The following prominent points are brought out in the study so far.

- 1 - Records were secured of the history and progress of an infestation enduring for 11 years under natural conditions.
- 2 - During this period the annual losses have totaled 4.81% of the stand.



- 3 - The highest annual loss amounted to 1% of the stand and the lowest .13%.
- 4 - Infestations under natural conditions fluctuate greatly from year to year.
- 5 - The causes of these fluctuations are not yet thoroughly understood.
- 6 - Infestation cycles are of approximately 4 or 5 years duration with corresponding peaks and low points occurring more or less regularly at these intervals.

CONCLUSION:

The greatest benefits to be derived from this study are the throwing of additional light on the periodicity of Dendroctonus brevicomis epidemics in yellow pine and the percent of stand killed during epidemic, endemic, and normal periods, and the derivation of annual loss figures which may be used in the correlation of infestations with climatic conditions and the host condition of the trees attacked.



TABLE NO. I - Showing Volume and Percent of Stand Killed Annually by Dendroctonus brevicornis on the Rogue River Area During the Period 1914 to 1924 Inclusive.

<u>Year of loss</u>	<u>Number of trees</u>	<u>Total volume in board feet</u>	<u>Percent of stand</u>	<u>Percent of increase or decrease over precd. year.</u>	
				<u>Increase</u>	<u>Decrease</u>
1914	369	346,390	.2		
1915	1,857	1,615,940	1.	366%	
1916	1,630	1,383,480	.9		14.4%
1917	803	608,005	.4		56 %
1918	1,187	1,085,315	.7	78%	
1919	780	674,270	.45		37%
1920	609	462,050	.35		31 %
1921	383	283,440	.18		38 %
1922	577	390,050	.25	40%	
1923	318	199,680	.13		23 %
1924	687	443,220	.28	82%	
Totals	9,200	7,491,840	4.81		



TABLE NO. II - Cycle of Dendroctonus brevicomis infestation in yellow pine on the separate units of the Rogue River Area from 1914 to 1924.

Unit.	Year.	Number of trees.	Volume in board feet.	% of pine stand.	Percent of increase or decrease over preceding year. In volume.	
					Increase.	Decrease.
Mistletoe	1914	23	34,900	.1		
	1915	130	140,660	.4	303%	
	1916	205	223,440	.6	59%	
	1917	125	87,260	.2		60%
	1918	469	429,650	1.2	392%	
	1919	244	245,330	.8		43%
	1920	168	129,080	.4		47%
	1921	115	103,500	.3		20%
	1922	144	106,500	.3	3%	
	1923	76	53,980	.11		50%
	1924	150	112,500	.3	108%	
	Total	1,869	1,666,800	4.76		
Lamb's	1914	56	56,190	.4	250%	
	1915	254	208,770	1.4	273%	
	1916	169	108,430	.7		48%
	1917	63	39,010	.2		64%
	1918	82	69,590	.4	79%	
	1919	46	31,550	.2		53%
	1920	18	14,520	.1		54%
	1921	24	20,450	.1	41%	
	1922	51	44,050	.3	120%	
	1923	32	18,940	.1		57%
	1924	25	25,420	.17	34%	
	Total	820	636,920	4.25		
Ashland	1914	45	56,250	.2		
	1915	213	226,820	1.	315%	
	1916	379	311,050	1.4	37%	
	1917	146	114,590	.5		63%
	1918	202	199,130	.9	74%	
	1919	46	38,800	.2		80%
	1920	12	12,960	.06		66%
	1921	13	11,700	.05		9%
	1922	30	28,700	.1	145%	
	1923	14	10,660	.05		63%
	1924	27	16,350	.08	53%	
	Total	1,127	727,010	3.3		



TABLE NO. II - Continued:

Unit.	Year.	Number trees.	Volume in board feet.	% of pine stand.	Percent of increase or decrease over preceding year. In volume.	
					Increase.	Decrease.
Frederick	1914	16	22,400	.7		
	1915	60	80,800	3.	261%	
	1916	89	87,530	3.	8%	
	1917	68	52,800	2.		37%
	1918	57	46,915	1.7		11%
	1919	44	35,200	1.2		25%
	1920	13	15,730	.6		55%
	1921	5	4,250	.15		73%
	1922	7	5,250	.2	23%	
	1923	3	2,400	.1		54%
	1924	7	4,790	.17	100%	
	Total	369	358,065	12.8		
Wagner	1914	50	50,400	.2		
	1915	285	339,840	1.3	574%	
	1916	286	303,890	1.		11%
	1917	130	138,150	.4		60%
	1918	175	212,430	.6	54%	
	1919	142	166,850	.5		21%
	1920	78	84,240	.2		50%
	1921	44	39,600	.1		53%
	1922	56	44,800	.13	13%	
	1923	28	21,000	.06		53%
	1924	96	74,880	.23	257%	
	Total	368	1,476,080	6.4		
Coleman	1914	70	77,000	.3		
	1915	345	323,250	1.2	297%	
	1916	184	155,040	.6		52%
	1917	95	93,100	.3		40%
	1918	70	70,000	.2		25%
	1919	78	74,100	.2	6%	
	1920	52	29,640	.1		60%
	1921	30	18,540	.05		40%
	1922	43	27,950	.1	50%	
	1923	25	17,500	.05		37%
	1924	84	54,600	.2	212%	
	Total	1076	940,720	3.36		
Griffin	1914	35	35,250	.3		
	1915	230	221,000	2.2	539%	
	1916	176	167,300	1.6		24%
	1917	93	66,490	.6		60%
	1918	52	41,600	.4		37%
	1919	72	57,600	.5	38%	
	1920	40	22,800	.2		60%
	1921	42	30,400	.25	33%	
	1922	49	34,300	.3	12%	
	1923	26	18,200	.15		47%
	1924	97	58,200	.58	220%	
	Total	912	751,140	7.5		



TABLE NO. II - Continued:

Unit.	Year.	Number trees.	Volume in board feet.	% of pine stand.	Percent of increase or decrease over preceding year. Vol.	
					Increase.	Decrease.
Gold Ray	1914	80	16,000	.1		
	1915	340	74,800	.7	367%	
	1916	142	26,800	.3		84%
	1917	83	16,600	.1		38%
	1918	80	16,000	.1		4%
	1919	108	24,840	.28	55%	
	1920	60	24,000	.24		3%
	1921	110	55,000	.55	56%	
	1922	197	98,500	1.	80%	
	1923	114	57,000	.57		42%
	1924	201	96,480	.96	69%	
	Total	1,515	506,020	5.06		
Total for Area		9,200	1,491,840	4.8		



DIAGRAM NO. 1 - Showing percent of stand killed on the  
Rogue River Area, and on each unit, from 1914 to 1924 incl.

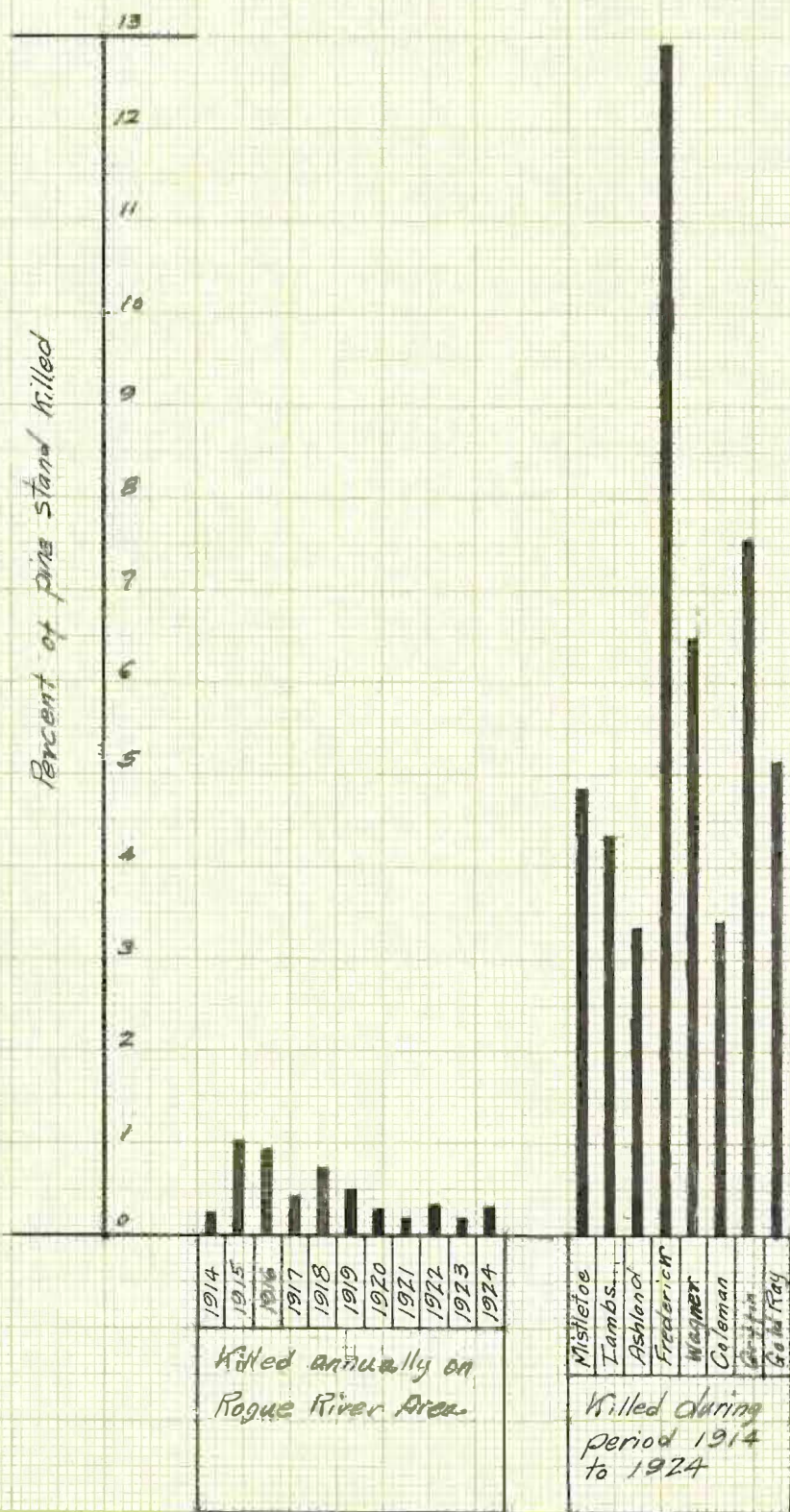




DIAGRAM NO. 2 - Curve of Dendroctonus brevicornis infestation on the  
Rogue River Area from 1914 to 1924 inclusive.

Percent of  
stand killed





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## SUMMARY OF BARK COUNTS

### NORTH FORK STATION.

1925 J W M

During the winters of 1923 and 1924 a series of bark examinations were made at the Northfork Station to secure quantitative data on the relative abundance of D. brevicornis broods in yellow pine bark.

Trees No. 1. 1602 and P. 1640 were both overwintering brood trees of the 1923 season. These trees were felled and two bark samples taken at 5' intervals for the entire height of the tree. One bark sample was worked up and a count made of the overwintering brood. The other bark section was placed in rearing and the number of exit holes counted after the brood emerged. The results of this study are fully covered in Miller and Person's report of April 6, 1924, entitled "A Quantitative Study of D. brevicornis Broods, their Mortality, the Effect of Predators, and Emergence Periods for D. brevicornis and T. nigricornis."

During the fall of 1924 a series of trees were cut in the Cascadell Unit and bark samples counted at regular intervals by Mr. Person. These records have not yet been summarized.

During the winter of 1924 and 1925 Mr. Wagner made bark counts from 48 trees in connection with the experimental control work on the Oat Mountain project. Two square feet were collected at each ten-foot interval up to the 8 inch diameter at the top. All of this bark was examined whether it was infested or not. The number of attacks were counted and the relative abundance of the brood checked off. A summary of the counts from each tree is given in the following table:



TABLE 1.

Summary of counts from trees cut by Wagner on the Cascadel and Oat Mt. units, Feb. to April 1925. All yellow pine D.b. trees. 2 Sq. Ft. of bark were selected and counted at 10' intervals along the tree.

Tree No.	:No.Sq.Ft.:	:No.Sq.Ft.:				
	:Examined	:Attacked	:Total No.:	Max.per:	Min.per	:Average per
		: by D.b.	: Attacks :	Sq.Ft.:	Sq.Ft.:	Sq. Ft.
H 729	18	12	98	29	4	8.1
H 733	8	8	37	14	3	4.6
H 716	18	14	69	14	2	4.9
H 735	20	14	62	15	3	4.4
H 754	16	6	40	15	11	6.6
H 747	2	2	21	21	21	10.5
H 742	6	2	11	11	11	5.5
H 709	22	16	141	29	5	8.8
H 717	22	16	142	48	4	8.9
H 746	14	8	40	12	8	5
H 712	22	20	96	15	4	4.8
H 713	16	14	20	4	2	1.4
H 704	18	12	72	17	5	6
H 727	20	20	239	37	4	11.9
H 436	10	6	26	16	5	4.3
H 489	18	14	156	32	2	11.1
H 498	20	20	79	12	2	3.4
H 437	22	12	122	27	6	10.1
H 438	22	16	60	11	2	3.7
H 490	18	10	47	14	6	4.7
H 496	10	2	10	10	10	5
H 500	10	6	24	4	11	4
H 492	8	2	6	6	6	3
H 495	8	2	7	7	7	3.5
H 494	10	2	11	11	11	5.5
H 743	20	14	94	22	5	6.7
H 493	8	2	9	9	9	4.5
H 731	16	12	79	19	4	6.5
H 714	18	14	23	6	1	1.6
H 706	18	10	39	14	2	3.9
H 734	18	14	39	6	2	2.7
H 721	22	20	281	44	2	14.05
H 705	18	12	67	14	7	5.5
H 752	16	4	33	19	14	8.2
H 736	20	14	66	12	4	4.8
H 744	18	12	169	42	11	14.07
H 728	12	12	87	28	3	7.2
H 732	16	8	67	26	10	8.3
H 730	18	14	99	22	5	7.07
H 708	8	4	20	11	9	5
H 715	18	10	18	6	1	1.8
H 707	22	18	65	11	3	4.1
H 750	12	6	13	6	3	2.5
H 749	18	12	80	21	7	6.6
H 702	20	10	35	9	4	3.5
H 434	22	16	118	27	3	7.5
H 726	20	16	109	26	3	6.7
H 720	16	16	114	32	1	7.1
Total	772	526	3360	865	268	
48 Trees	Average			18.5	5.6	6.38

percent of bark infested - 68.1%



The following bark counts were made by Wagner during the winter of 1924-25,

Tree No. T. G. 36, Northfork Unit - yellow pine: D.B.H. 30 in; ht. 130. Tree felled, Jan. 1924, brood at that time consisted of  $\frac{1}{2}$  to full grown larvae in outer bark. 13 square feet of bark were removed from the tree at varying heights. Each square foot section was cut in two pieces, each 6" x 12". One piece was counted out to determine the number of entrance holes and numbers of overwintering brood. The other piece was placed in rearing for the season. In Jan. 1925, the reared bark was counted for exit holes and dead brood in the bark. The object was to determine the extent of mortality between the larval stage and emergence.

	A. Bark Counted 1924	B Bark Reared and counted - 1925
Total No. entrance holes (13 sq.ft.)	107	94
" " live larvae	1139	
" " dead "		118
" " exit holes		708
Mortality in (b) dead larvae)	14.4%	
" " (b) compared with (a)	37.8%	
Av. entrance holes per sq. ft. (a and b)	15.5	holes
Av. larvae per sq. ft. (a)	87.6	
Av. exit holes per sq. ft. (b)	54.4	



Tree # H 435 - Summer brood tree - Northfork Unit - D.B.H. 30.  
 Tree felled Jan 23, 1925 - bark sections examined to determine  
 normal mortality of brood in standing trees.

Bark Sect. No.	Ht. Above Ground	Dim.	Entrance Holes	Exit Holes	Dead Brood	Remarks
1	10	:12x24:	7	18	8	:Dead brood - 4 new adults, 2 pupae, 2 larvae, all covered with mould fungus. 2 live trogositid and 3 live clerid larvae. Roundhead and flathead larvae also alive.
2	15	:12x24:	17	10	2	:Dead brood - 2 new adults - 1 partly eaten by predator. 1 live Trogositid larvae, 1 dead Trog. larvae, 1 live Ips larvae
3	25	:12x24:	13	33	1	:Dead brood - 1, new adult. 3 live Trogositid larvae, 1 dead Trog. larvae, 3 small D.b. larvae alive.
Total		:6 Sq.Ft:	37	51	11	

Mortality of D. brevicornis in bark ----- 17.7%

Average No. attacks per sq. ft. ----- 6.3

Average No. exit holes " " " ----- 8.5



Tree # G. 767 W.

Winter brood tree, windfall, Northfork District, D.B.E. 44 in., ht. 130. Tree felled Feb. 5, 1924. 21 bark sections of varying sizes collected at different heights along trunk. Each section was cut in half - onehalf was worked up and overwintering brood counted, the other half put in rearing for the season. In Feb. 1925 this bark was worked up and counted for exit holes and dead broods. The object was to determine extent of mortality between the larval stage and emergence.

	A Bark Counted 1924	B Bark Reared and Counted - 1925
Total No. live brood	3074	—
" " dead "	—	315
" " exit holes	<u>3074</u>	<u>1565</u> <u>1880</u>
Total No. square feet		13.9
Mortality in (b) (dead larvae)		16.7%
Mortality compared with (a)		38.8%
Av. No. larvae per sq. ft. (a)		221.1
Av. No. exit holes per sq. ft. (b)		112.4



Tree # H 437 - Summer brood tree, Northfork Unit D.B.H. 34.  
Felled, Jan. 1925 - bark sections examined to determine  
normal mortality of brood in standing trees.

Bark	Ht.	Along	Diam.	Entrance	Exit	Live	Dead	Remarks
Seot. No.	Ground			Holes	Holes	Brood	Brood	
						15 Lar.	3 live	Clarid larvae
1	10	12 x 12	13	36	2 Adl.	0	1	" roundhead
2	10	"	8	19	8 Lar.		3 live	Trog. larvae
					3 Adl.	0	2	" Clarid "
3	20	"	9	62	16 Lar.	1 Adl.		-
4	20	"	11	59	11 "	0	1 live	Trog. larvae
5	30	"	4	43	6 "	0	1 live	Trog. "
							1 live	Trog. larvae
6	30	"	5	51	13 "	0	1	" Rubberneck "
					21 "		1 live	Trog. larvae
7	40	"	7	67	2 Adl.	0	1	" flathead larvae
							1 live	clarid larvae
8	40	"	5	40	9 Lar.		2	" Trog. "
					2 Adl.	0	1	" roundhead larvae
							1 live	Trog. adult
9	50	"	6	35	-	-	2	roundhead larvae
							1 live	Trog. larvae
10	60	"	9	65	-	-	1	" rubberneck larvae
Total			77	500	106		1	

Total No. sq. ft. of bark counted	10
Av. no. entrance holes per sq. ft.	7.7
No. exit holes per sq. ft.	50.
No. exit holes and unemerged brood, per sq. ft.	10.6
Mortality %	.005



Tree # H 718 - Summer brood tree, Northfork Unit D.B.H 22 in.  
80 ft. high. Felled in April 1925 and bark examined to determine mortality  
of D. brevicornis brood in bark.

Bark Sect. No.	Height : : Above : : Dim.	Entr- : : ance : : Ground :	Exit : : Holes : : Holes :	Live : : Brood : : Brood :	Dead : : Food : : Food :	Remarks.
1	12 x 24	2	29	6	- 1 Lar. 3 Lar.	
2	"	7	26	24	- 1 Adl. 1 live clerid larvae 7 Lar.	
3	"	12	24	29	- 1 Adl. 3 "	" " "
4	"	17	18	65	- 9 Lar. 4 "	" " "
5	"	22	15	52	- 8 " 3 "	" " "
6	"	27	14	36	- 10 " 2 "	" " "
7	"	32	16	22	- 6 " 2 "	" " "
8	"	40	11	6	- 4 " -	
Total	165 sq. ft.		153	238	59	

Aver. No. attacks per sq. ft. ----- 9.5  
" " exit holes " " ----- 14.8  
" " clerid larvae " " ----- .9

Brood mortality indicated by dead brood  
compared with exit holes in bark ----- 19.8%

Generation mortality - Adults, attacking per sq. ft.  
(9.5 x 2.5) compared with adults emerging " " " ----- 60.5%

Brood mortality is undoubtedly much higher than indicated by these counts. Apparently only a small number of the dead brood found by this examination. Much of this may have occurred in very early larval stages and could not be seen in slicing bark. The no. of live clerid larvae indicates that they may be responsible for much of this mortality.



Tree # 486 - Summer brood tree, Northfork District. D.B.H. 20.  
Felled in Jan. 1925 and bark examined to determine mortality of  
D. bravigianis brood in bark.

Bark Sect. No.	Diam.	Height: : Above : : Ground :	Entrance: Holes :	Exit: Holes :	Live Brood :	Dead Brood :	Remarks:
1	12 x 12	10	5	15	-	-	1 live Trog. larvae
2	"	10	10	22	-	-	1 live clerid "
3	"	20	4	1	-	-	-
4	"	25	7	10	-	-	-
5	"	25	5	16	-	-	-
6	"	30	4	8	-	-	1 live Trog. larvae
7	"	30	5	11	"	-	1 live Hymenidid "
8	"	40	4	5	-	-	-
9	"	40	3	20	1 Lar.	-	-
Total			47	115			

No. attacks per sq. ft. ----- 5.2  
Emergence " " " ----- 12.63  
No. predator larvae per sq. ft. ----- .3  
Brood mortality as indicated by  
dead brood compared with exit holes  
in bark ----- 0  
Generation mortality - adults attacking  
per sq. ft. (2.5 x 5.2) compared with  
exit holes in bark ----- 2.%



Counts made of 1924 overwinter trees and bark placed in rearing - records incomplete.

Tree No. H. 439 - Winter brood tree, Northfork Unit, D.B.H 30 in. Felled Dec. 1924. Bark examined to determine numbers of overwintering broods and check against rearing.

No. sq. ft. of bark counted	-----	13.
Total No. larval brood	-----	3071.
Av. larvae per sq. ft.	-----	236.2
Av. <del>lar</del> entrance holes per sq. ft.	-----	7.9
No. square feet of bark placed in rearing	-----	11.

Tree No. 481. Winter brood tree, Northfork Unit - D.B.H. 24 in. Felled Feb. 1925. Bark examined to determine numbers of overwintering broods as check against rearing.

No. sq. ft. of bark counted	-----	5.
Total No. larval brood	-----	534.
Av. larvae per sq. ft.	-----	89.
Av. entrance holes per sq. ft.	-----	6.58
No. square feet of bark placed in rearing	-----	6.